

# OpenDICE (v1.2) User Manual

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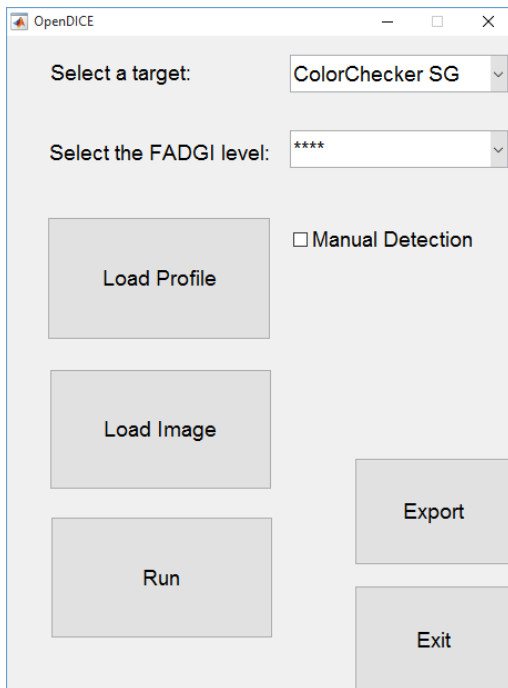


Figure 1. OpenDICE user interface

1. In the interface (Figure 1), the default setting for the target is ColorChecker SG. User may change it to DICE.
2. The default FADGI level for image quality assessment is 4 star, which may be changed to 3 or 2 star. If the analysis results fail to meet 2 star level, then it's 1 star level. A configuration file is provided to allow the user change the criteria settings (Figure 2). The current values follow the specifications in FADGI v2010.

	A	B	C	D
1	FADGI Criteria	****	***	**
2	Hi_freq Low	0.95	0.9	0.8
3	Hi_freq Up	0.2	0.3	0.4
4	Mid_freq Low	0.45	0.35	0.25
5	Mid_freq Up	0.65	0.75	0.85
6	Sampling Freq	0.005	0.0075	0.015
7	Nyquist Amp	0.2	0.3	0.4
8	Sharpening	1	1.1	1.2
9	OECF band	3	6	9
10	White Balance	3	4	6
11	Uniformity	0.01	0.03	0.05
12	Noise	2.5	4	6
13	Max DeltaE	6	10	15
14	Mean DeltaE	3	5	10
15	Max DeltaEab	3	5	8
16	Mean DeltaEab	2	3	6
17	Color Regis	0.33	0.5	0.8
18				
19				

Figure 2. FADGI criteria values

3. (1). User will load the profile first according to the target selection. It should be an Excel file, with the measurements as the ground truth for color accuracy assessment ( $L^*a^*b^*$ ) and tonescale analysis (density), respectively. For example, a DICE profile and a Colorchecker SG profile are shown in Figure 3 and Figure 4.
  - (2). The profile format is strictly defined, with the  $L^*$ ,  $a^*$ ,  $b^*$ , and D as the table head. The patches are listed from 1 to 30 (DICE), or from A1...A10 to N1...N10 (Colorchecker SG).
  - (3). Note that the DICE target has density measurements for its 12 gray patches (#10 - #21), and Colorchecker SG target has density measurements for its central 12 gray patches (#E5 - #J6).
  - (4). The profile must match with the selected target, otherwise an error message will be displayed. Then user may reselect either the profile or target.

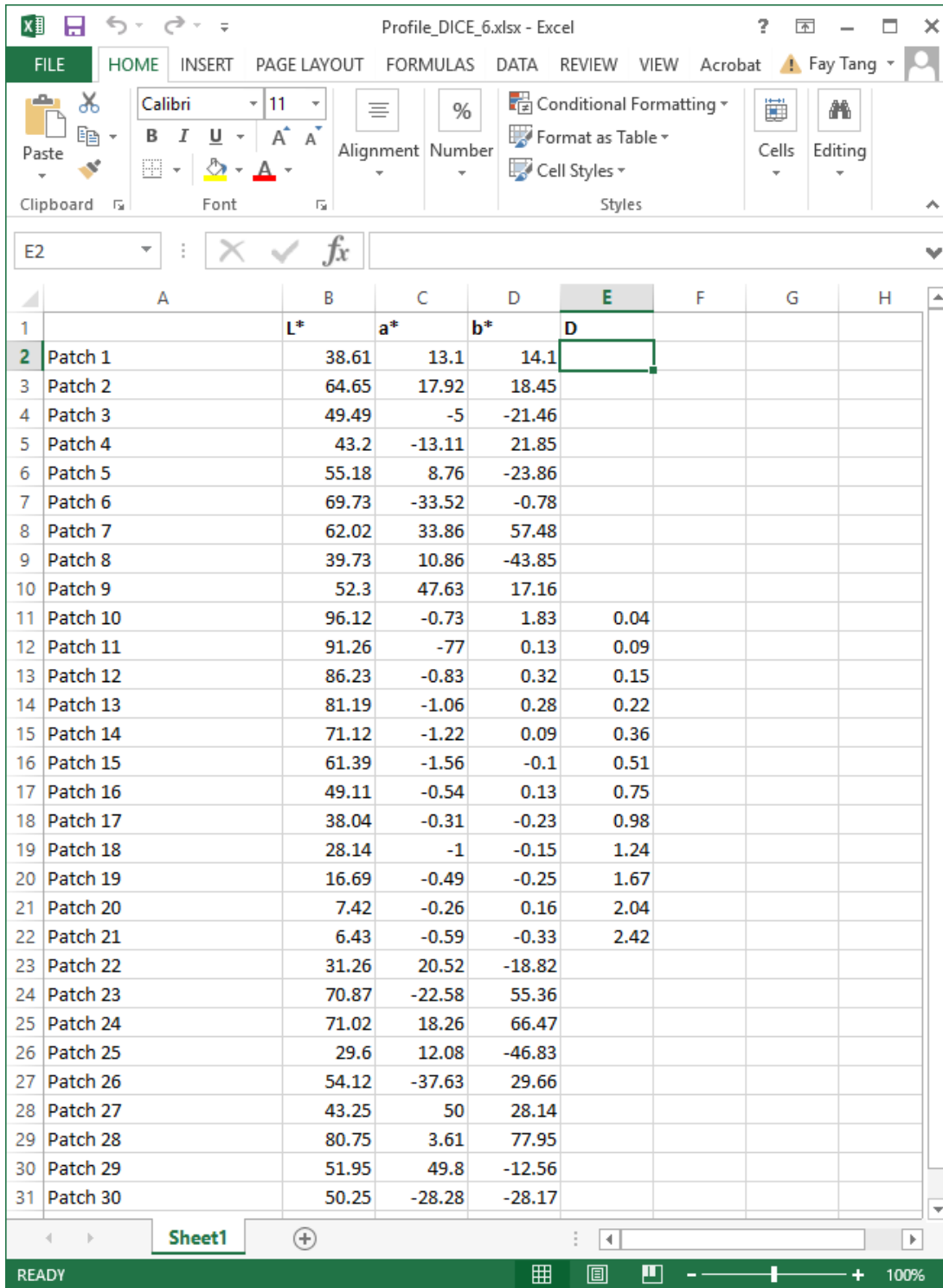


Figure 3. DICE target profile with the L\*a\*b\* and density (D) measurements

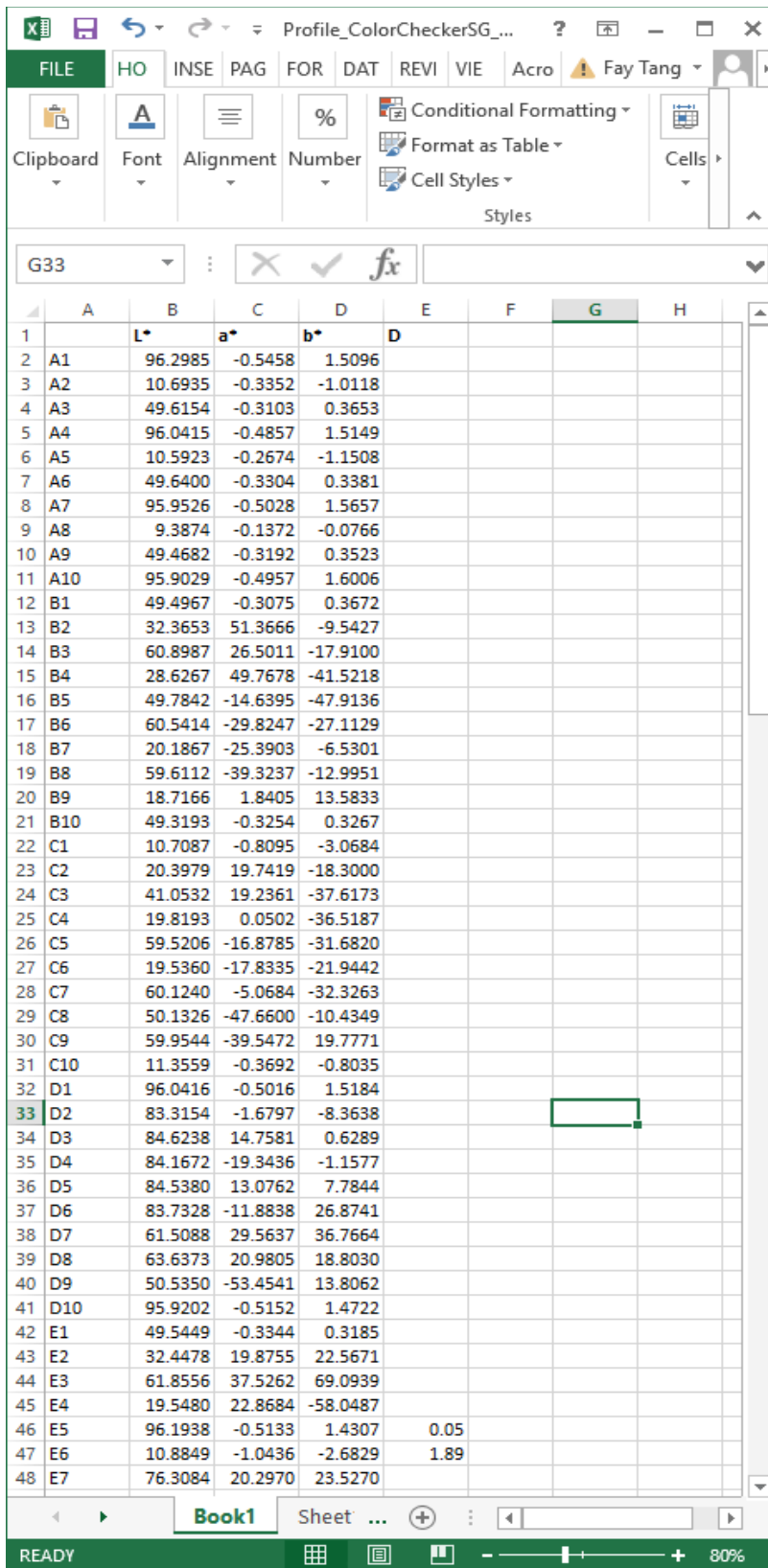


Figure 4. Colorchecker SG target profile with the L\*a\*b\* and density (D) measurements

4. After loading the profile, user may import the target image for quality assessment. Similarly, the image must match with the target. Otherwise an error message will be display for re-selection. With the current version, OpenDICE support only well scanned images with tilt angle less than  $5^\circ$ , i.e., no automatic rotation or adjustment is applied to the input image.
5. Once the image is loaded, the regions of interest (ROI) on the image will be automatically identified, as shown with the rectangles. User may resize or drag the rectangles for minor location adjustment. If the ROI are far away from the ideal regions, manual selection is suggested, i.e., user check the Manual Detection option and load the image again.  
Note that manual detection generally provides faster and more accurate ROI identification, with the user interaction. User must click the four corner points (for DICE targets) or cross points (for Colorchecker SG) in a clockwise manner (double click is needed for the last click on point 1 when finish the loop), see Figure 5.

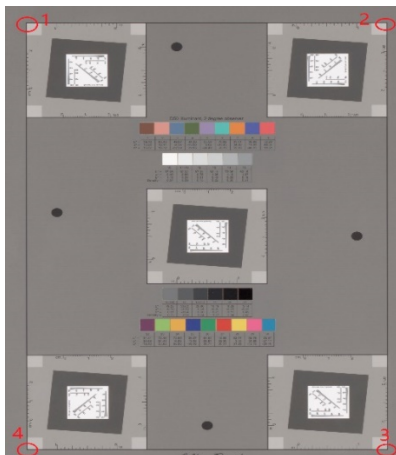


Figure 5. Landmark points for user manual selection to identify the ROI

6. Once the ROI are identified, user will see the images overlapped with a set of rectangles, see Figure 6. In this identification process, user cannot click any buttons on the interface. Again, user may be drag or resize the rectangles for more accurate location. Depending on the image size, this step may take a couple of minutes to identify the ROI on Colorchecker SG images. In such cases, we recommend Manual Detection option before loading the image.

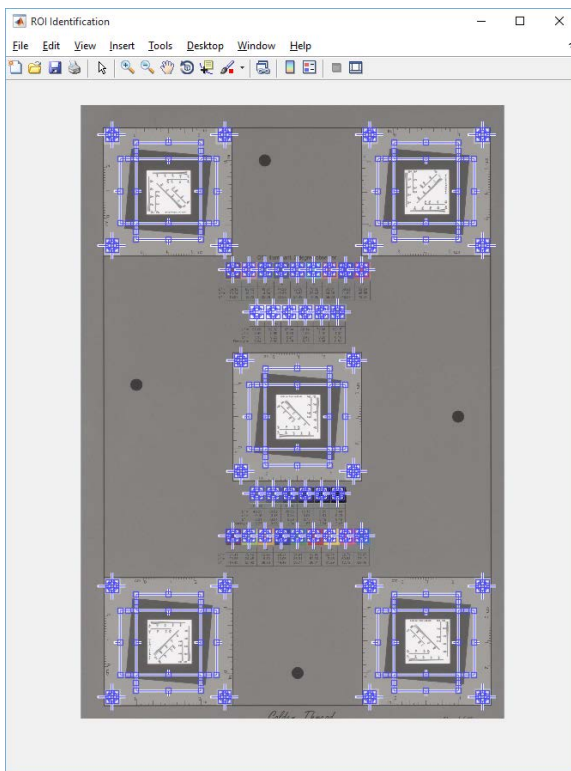
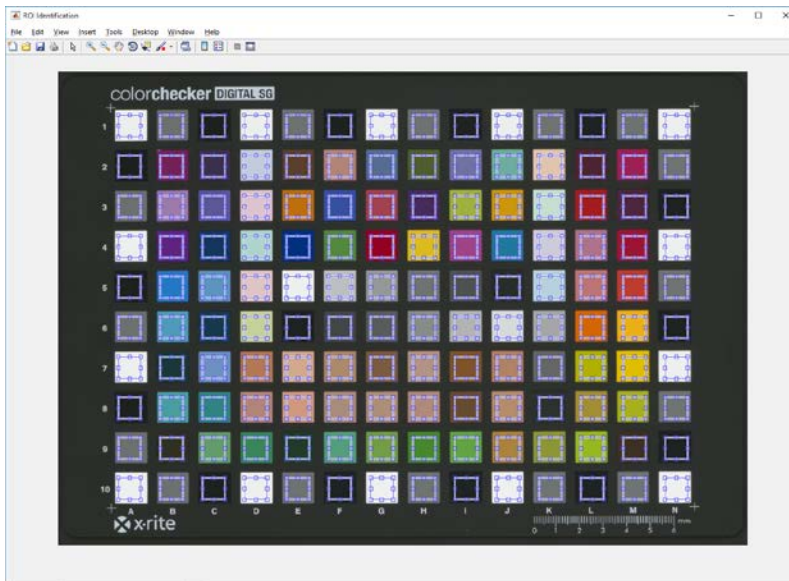


Figure 6. ROI identification for Colorchecker SG and DICE target images.

7. User confirm the ROI are acceptable, then click Run button to start assessment. The assessment results are displayed on two (Colorchecker SG target) or three (DICE target) windows. For the Colorchecker SG target, the first window displays color accuracy analysis results and the second window presents tonescale analysis results. DICE target images have the third window for resolution analysis results.

(1). Color accuracy window consists of four tabs: Luminance, Delta E 2000, Color Registration Accuracy, and Summary.

Luminance tab shows the difference between the aim (ground truth from the measurements) and the actual image values for all patches, as shown in Figure 7.

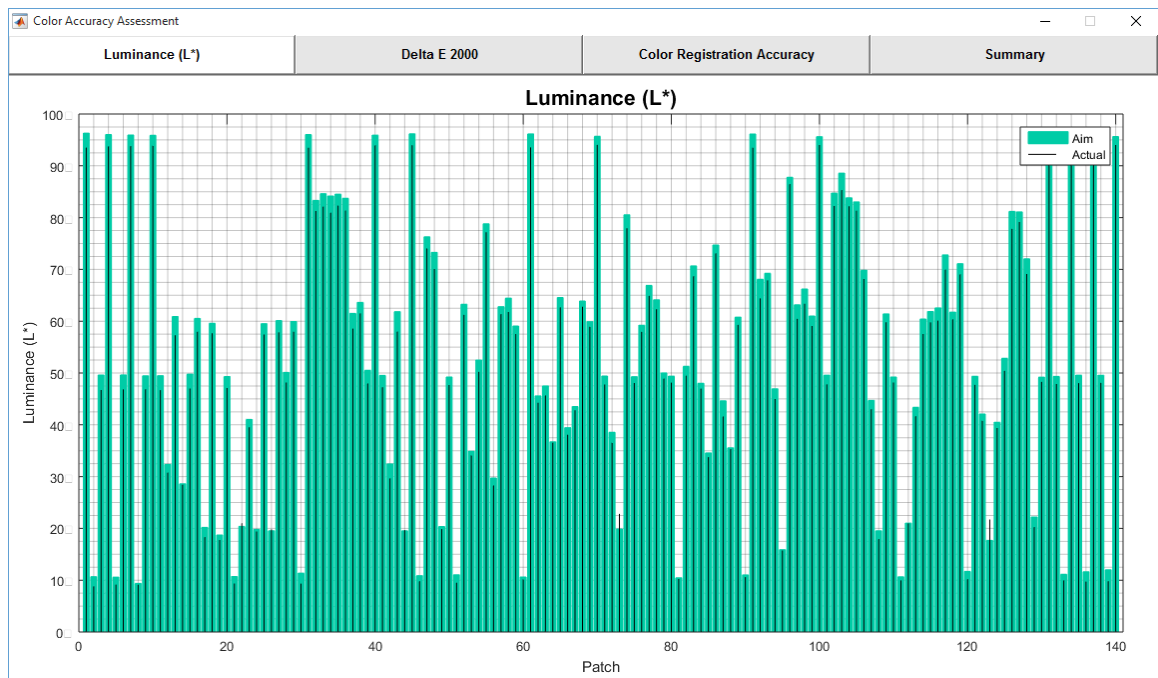


Figure 7. Luminance tab in Color Accuracy Analysis window

Delta E 2000 tab shows the  $\Delta E_{2000}$  between the ground truth and the actual image values for all patches, as shown in Figure 8. The vertical black lines with black dots represent the actual  $\Delta E_{2000}$  values, and the vertical red lines with red dots show the actual  $\Delta E_{2000}(a*b^*)$  values. The horizontal magenta line shows the maximum upper limit for  $\Delta E_{2000}$  according to the user FADGI level selection. Similarly, the horizontal blue line shows the mean upper limit for  $\Delta E_{2000}$ . The horizontal black line shows the actual mean  $\Delta E_{2000}$ , and the horizontal green line shows the actual median  $\Delta E_{2000}$ .

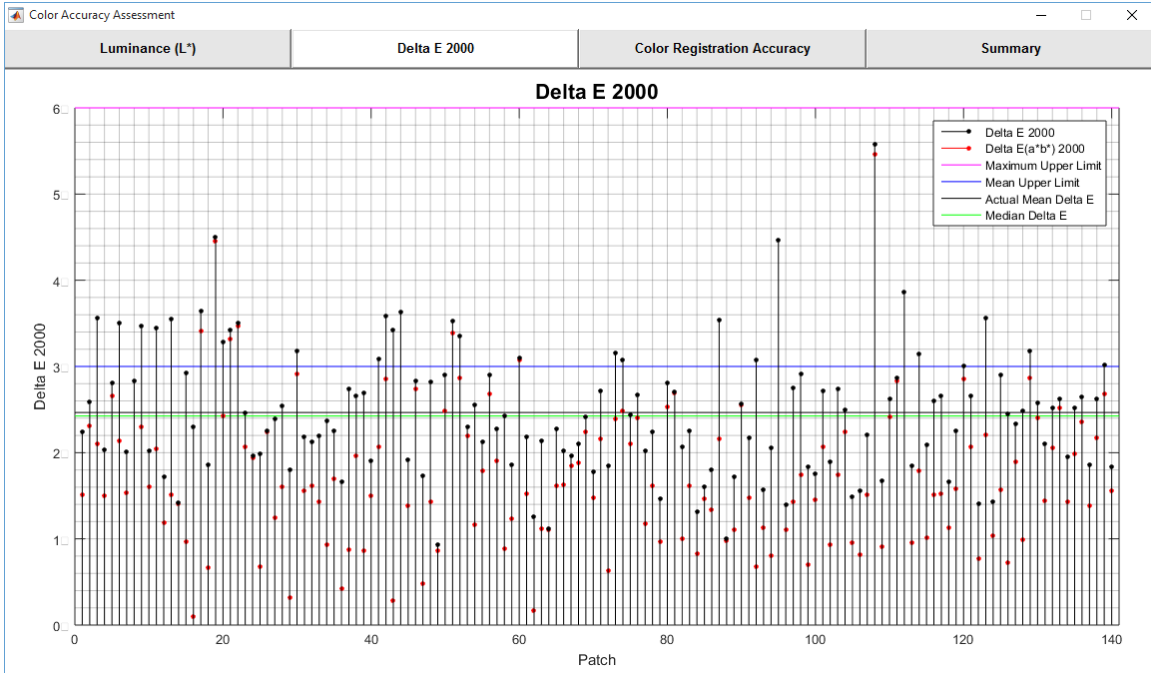


Figure 8. Delta E 2000 tab in Color Accuracy Analysis window

Color Registration Accuracy tab is not applicable to Colorchecker SG target. Figure 9 shows an example of DICE target.

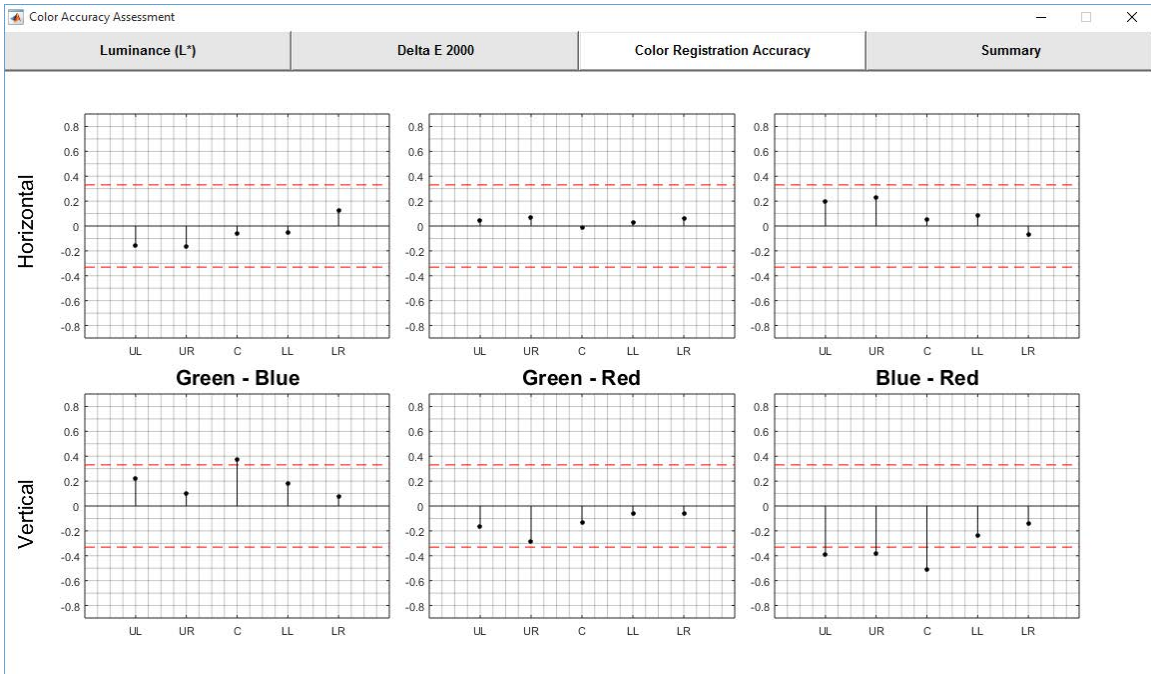


Figure 9. Color Registration Accuracy tab in Color Accuracy Analysis window (only for DICE target)



Summary tab shows the detail results (value) according to the FADGI guideline performance level (lower limit and upper limit), see Figure 10.

Measurements	Pass/Fail	Lower Limit	Value	Upper Limit
<b>FADGI Performance Level: -----4 star -----</b>				
Max DeltaE 2000	Pass	0.0	5.6	6.0
Mean DeltaE 2000	Pass	0.0	2.5	3.0
Median DeltaE 2000			2.4	
Max DeltaE(a*b*) 2000	Fail	0.0	5.5	3.0
Mean DeltaE(a*b*) 2000	Pass	0.0	1.8	2.0
Median DeltaE(a*b*) 2000			1.6	
A1_DeltaE 2000	Pass	0.0	2.2	6.0
A2_DeltaE 2000	Pass	0.0	2.6	6.0
A3_DeltaE 2000	Pass	0.0	3.6	6.0
A4_DeltaE 2000	Pass	0.0	2.0	6.0
A5_DeltaE 2000	Pass	0.0	2.8	6.0
A6_DeltaE 2000	Pass	0.0	3.5	6.0
A7_DeltaE 2000	Pass	0.0	2.0	6.0
A8_DeltaE 2000	Pass	0.0	2.8	6.0
A9_DeltaE 2000	Pass	0.0	3.5	6.0
A10_DeltaE 2000	Pass	0.0	2.0	6.0
B1_DeltaE 2000	Pass	0.0	3.4	6.0
B2_DeltaE 2000	Pass	0.0	1.7	6.0
B3_DeltaE 2000	Pass	0.0	3.6	6.0
B4_DeltaE 2000	Pass	0.0	1.4	6.0
B5_DeltaE 2000	Pass	0.0	2.9	6.0
B6_DeltaE 2000	Pass	0.0	2.3	6.0
B7_DeltaE 2000	Pass	0.0	3.6	6.0
B8_DeltaE 2000	Pass	0.0	1.9	6.0
B9_DeltaE 2000	Pass	0.0	4.5	6.0
B10_DeltaE 2000	Pass	0.0	3.3	6.0

Figure 10. Summary tab in Color Accuracy Analysis window

(2). Tonescale analysis window consists of four tabs: OECF Curves, Difference to Aim, White Balance, Uniformity, Noise, and Summary.

OECF tab shows the OECF curves for RGB and luminance components, as shown in Figure 11. User may change the gamma, gain, and offset to adjust the curves in order to fit them into the range defined by the current FADGI level (magenta curves).

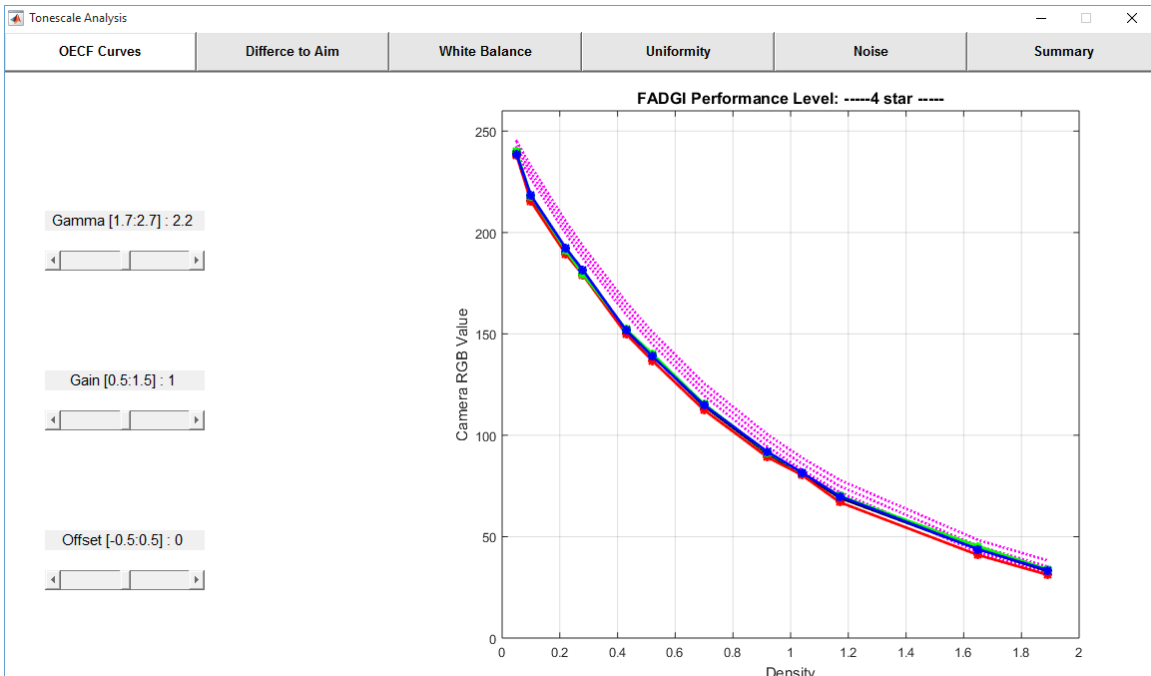


Figure 11. OEFC Curves tab in Tonescale Analysis window

Difference to Aim tab shows error of the OEFC curves, and the ideal range defined by the current FADGI level (magenta curves), see Figure 12.

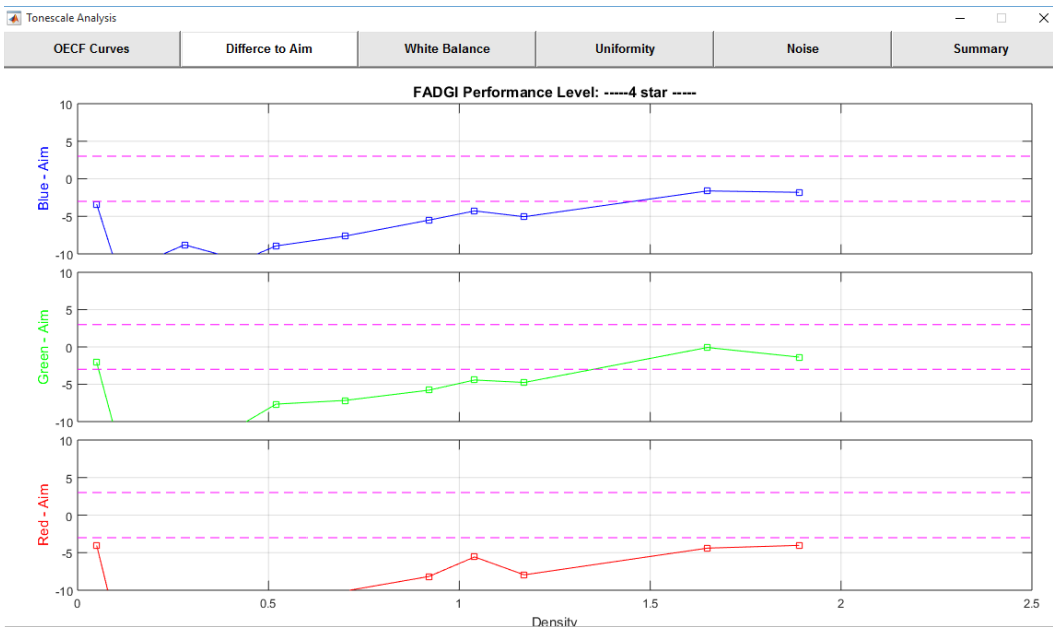


Figure 12. Difference to Aim tab shows the OEFC curve errors in Tonescale Analysis window

White Balance tab shows white balance error (blue-red, green-red, and green-blue) of the neutral patches, and the ideal range defined by the current FADGI level (magenta curves), see Figure 13.

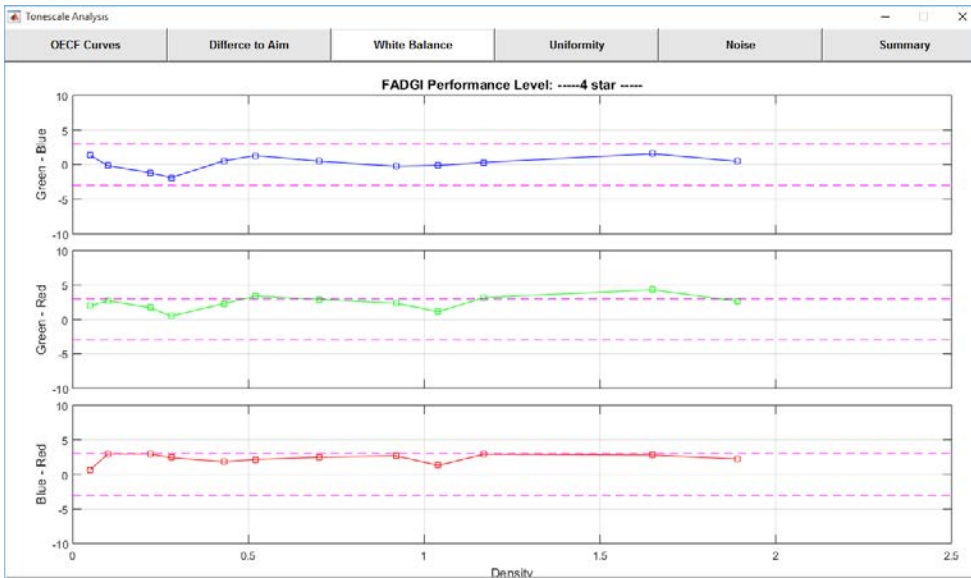


Figure 13. White Balance tab shows the white balance errors in Tonescale Analysis window

Uniformity assessment is not applicable to Colorchecker SG target. Figure 14 shows an example of DICE target.

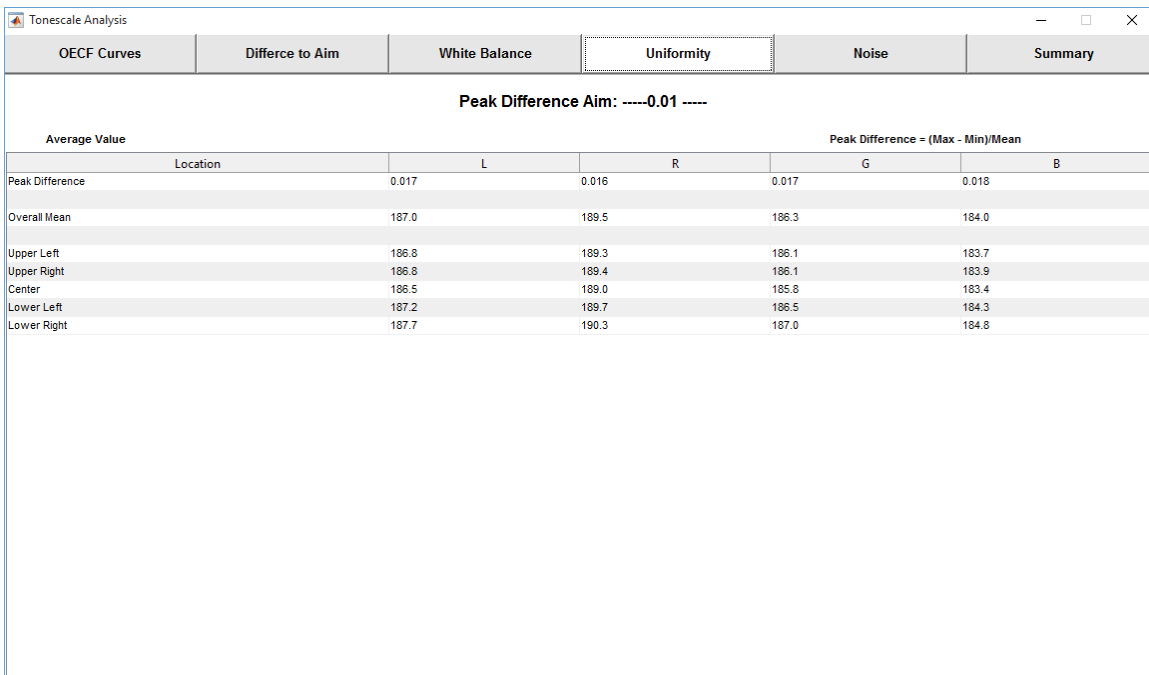


Figure 14. Uniformity tab shows the illuminance uniformity error in Tonescale Analysis window (only for DICE target)

Noise tab shows the noise level for the neutral patches, see Figure 15.

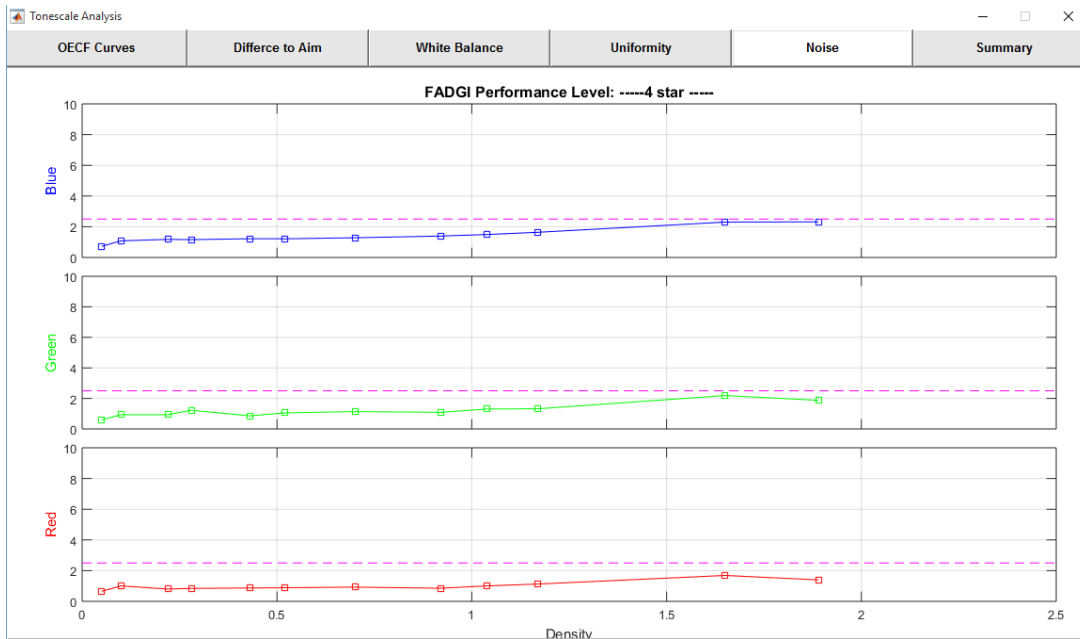


Figure 15. Noise tab shows the noise levels in Tonescale Analysis window

Summary tab shows the detail results (value) according to the FADGI guideline performance level (lower limit and upper limit), see Figure 16.

Measurements	Pass/Fail	Lower Limit	Value	Upper Limit
Tone Response				
E5 Red	Fail	239.0	237.9	245.0
E5 Green	Pass	239.0	239.9	245.0
E5 Blue	Fail	239.0	238.6	245.0
J6 Red	Fail	228.7	215.3	232.7
J6 Green	Fail	228.7	218.1	232.7
J6 Blue	Fail	228.7	218.2	232.7
F5 Red	Fail	199.6	189.5	205.6
F5 Green	Fail	199.6	191.2	205.6
F5 Blue	Fail	199.6	192.4	205.6
I6 Red	Fail	187.2	179.0	193.2
I6 Green	Fail	187.2	179.5	193.2
I6 Blue	Fail	187.2	181.4	193.2
G5 Red	Fail	159.6	149.9	165.6
G5 Green	Fail	159.6	152.2	165.6
G5 Blue	Fail	159.6	151.7	165.6
H6 Red	Fail	145.0	136.9	151.0
H6 Green	Fail	145.0	140.3	151.0
H6 Blue	Fail	145.0	139.0	151.0
H5 Red	Fail	119.6	112.4	125.6
H5 Green	Fail	119.6	115.4	125.6
H5 Blue	Fail	119.6	114.9	125.6
G6 Red	Fail	94.4	89.2	100.4
G6 Green	Fail	94.4	91.6	100.4
G6 Blue	Fail	94.4	91.8	100.4
I5 Red	Fail	82.9	80.3	88.9
I5 Green	Fail	82.9	81.4	88.9
I5 Blue	Fail	82.9	81.6	88.9

Figure 16. Summary tab shows the tonescale analysis results

(3). Specifically for DICE target, there is a resolution analysis window which consists of nine tabs: Efficiency, SFR (10%), SFR (50%), Center, Upper Left, Upper Right, Lower Left, Lower Right, and Summary.

Efficiency tab shows the average sampling efficiency for red, green, and blue components, see Figure 17.

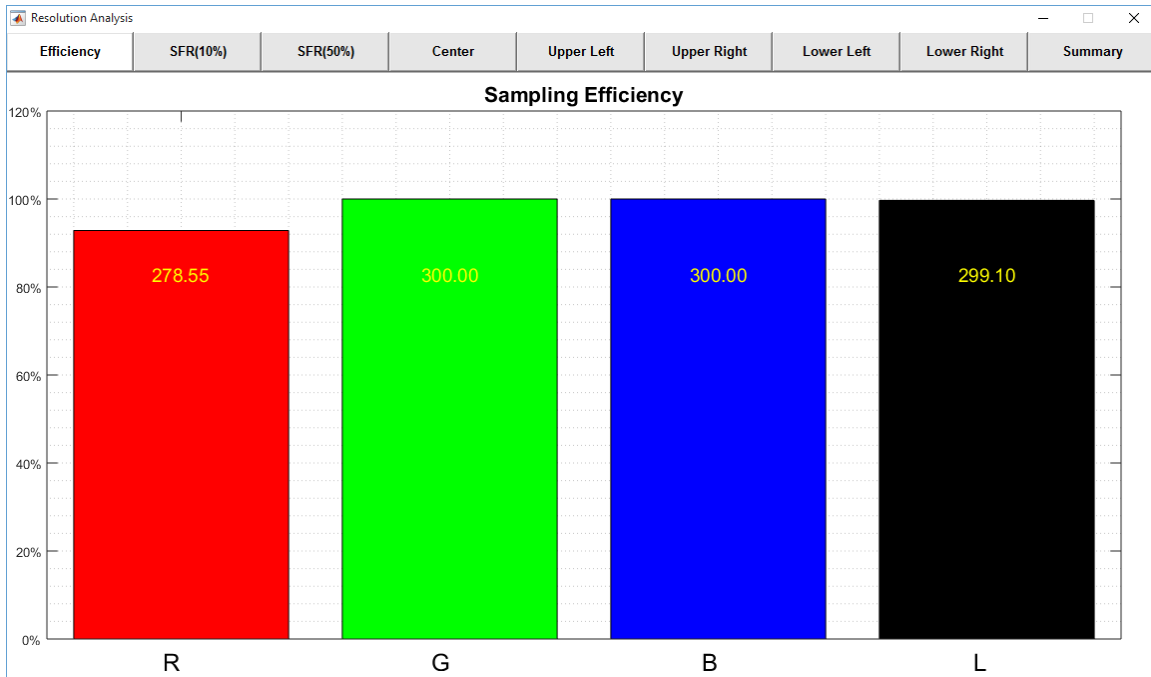


Figure 17. Efficiency tab shows the sampling efficiency values in resolution analysis window

8. With these results, user may click the Export button to write all the results to an Excel file as the results. The file will be saved in the same folder as that of the image, with an extension of the FADGI star level. Note that Microsoft Excel is required in order to write the results.